MODIFICATION OF WHEELCHAIR FUNCTION FOR HANDICAP PURPOSE USAGE

ZAIDIE BIN RAHIM

Report submitted in fulfillment of the requirements
for the award of the degree of
Bachelor of Mechanical Engineering with Automotive Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2009

ABSTRACT

This report is an outcome of the work I have carried out in doing and completing my final year project, the Modification of Wheelchair Function for Handicap Purpose Usage. The report starts off with an introduction wheelchair concerning of definition of important component of this topic such as definition of optimization, wheel chair and handicap. Then a further describe on the critical part of stress on the wheelchair. In this steps, from the knowledge gathered from the questionnaire is use to make a design refers to case data that suitable for the project. Several sketches have been made and only a few have been selected based on the suitability design. Based on the sketches, material needed in this project will be listed and suitable design will be selected. Next all the sketches will be draw into Solidworks 2006 software. Then, go through to simulation process by using FEA tools that is ALGOR software, the design was analyzed using constant force. Improvement of critical part of seating support and front tire design was compared based on material used, analysis on Stress Von Mises. At the end, when all the process mentioned above is done, the material for report writing is gathered. The report writing process will be guided by the Universiti Malaysia Pahang final year report writing guide. This process also included the presentation slide making for the final presentation of the project. The project ended after the submission of the report and the presentation slide has been presented.

.

ABSTRACT

Laporan ini adalah hasil dari kajian dalam menyiapkan Projek Sarjana Muda saya yang bertajuk “Mereka Bentuk Semula Fungsi Kerusi Roda Untuk Kegunaan Orang Kurang Upaya”. Projek dimulakan dengan pengenalan kepada tajuk-tajuk penting dan juga bahagian – bahagian yang akan dikaji menerusi projek ini. Ianya merangkumi maksud dan pengenalan mengenai proses optimunan, kerusi roda dan orang kurang upaya. Kemudian mengkaji dengan lebih lanjut mengenai bahagian yang paling tinggi tekanan dikenakan. Soal selidik yg dikumpul dijadikan sebagai rujukan utama dalam meneruskan projek ini. Selepas itu, beberapara lakaran dilukis dan dipilih berdasarkan bentuk yg sesuai bagi tujuan penganalisis seterusnya. Kemudian, kesemua lakaran yg dipilih itu dilukis semula di dalam program Solidwork 2006 bagi mendapatkan lukisan dalam bentuk 3 dimensi sebelum di masukkan kedalam Program FEA ALGOR untuk proses analisis daya tekanan. Seterusnya, penambahbaikan bahagian penting seperti pelapik tempat duduk dan tayar depan kerusi roda dikaji berdasarkan kekuatan tekanan Von Mises bergantung kepada jenis – jenis bahan yang digunakan dan dipilih megikut spesifikasi yang terbaik. Akhir sekali,laporan lengkap akan dirangka dan ditulis mengikut garis panduan yang ditetapkan oleh Universiti Malaysia Pahang.Selain laporan lengkap, slaid pembentangan juga akan disiapkan pada fasa teakhir projek ini. Projek ini berakhir dengan rasminya apabila ia berjaya dibentangkan dan laporan akhir dihantar.

.

TABLE OF CONTENT

CHAPTER 4 RESULT AND DISCUSSION

CHAPTER 5 CONCLUSION

LIST OF TABLE

LIST OF FIGURES

LIST OF SYMBOLS

ac	Acceleration
r	Radial Position
$\dot{r}$	Radial Displacement Speed
S	Displacement
So	Initial Displacement
t	Time
V	Velocity
Vo	Initial Velocity
θ	Angle
$\dot{\theta}$	Angular Displacement Speed

LIST OF ABBREVIATIONS

3-D	Three Dimensional
AC	Automatic Control
CAD	Computational Aided Design
DC	Direct Current
FEA	Finite Element Analysis
RPM	Rotational Per Minutes

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Earlier wheelchairs used belts in the drive-train. The motor turned a rotor which had a belt wrapped around it, and the belt transmitted the power to the wheels. Today's wheelchair use direct drive, meaning the motor turns gears which in turn move the power through a gear transmission to the wheels. Direct drive is more reliable and needs less maintenance.

Basically, this wheelchair was called as electric chairs until have a marketer declare this product to the public as an electric wheel chair. This product content with batteries, motor, hydraulic system and the suitable seat and it's also using the drive mechanisms.

That product also was used for daily life activities such as old people, lady pregnant and for sport. By the way, for the athletes' mobility this design should be redesign suitable with their function and their own shape.

This chapter discussed about project background and the history about wheel chair. Its include the problem statement and objectives. The important thing is problem statement to create the objective. The scopes were already used for this project because we don't throughout this project of out of topic.

1.2 PROBLEM STATEMENT

Wheelchair system is one of the common vehicle is limited in its functions, such as it needs human force to move it. It is also can't be use for a long period as the user will be tired in moving the chair using his or her own energy. Then, the other problem is the existence wheel chair is also not really comfortable as the shape and its position also cannot be fixing to the user's body in getting comfortable seat. The storage compartment was really important because it has no spaces to store the user's things and his or her daily stuff.

1.3 PROJECT OBJECTIVES

The objectives of this thesis are to:

(i) Identify suitable general wheel chair for the usage of handicap people.
(ii) Redesign the wheelchair to for handicap people.
(iii) Analyze the critical part of wheelchair design using ALGOR software.

1.4 PROJECT SCOPE

This project is confined to the following scopes of study:

(i) Identify and selected the suitable wheel chair for daily life activity.
(ii) Redesign of Wheel chair drawing using CADCAM software with Solidwork 2006.
(iii) Analysis the strength of the redesign drawing using as ALGOR software.
(iv) Simulate the prototype of product by ALGOR software.

1.5 ARRANGEMENT OF REPORT

This study will be divided into 5 chapters. In the first chapter, the introduction of the study will be discussed. This chapter provides the problem statement of the study. Then a brief introduction to the project about the wheel chair. Next, it also discusses about the project statement, project objectives and project scopes to carry out the project.

Chapter two consists of literature review concerning of definition of important component of this topic such as definition of optimization, wheel chair and handicap. Then, it also involve about the type of wheel chair that already used today. Lastly, this chapter ends with the previous research of handicap purpose.

Chapter three discusses about process flow that used for this project. Its include with identifying the suitable product. Then, the most important part is to evaluate the sketching of wheel chair. Its include the operational function and the problem or disadvantages of product. For the next step was doing the drawing of product using Solidwork 2006. Lastly, the material selection for every part of wheel chair that has been selected.

Chapters four was include the design process are based on the result of questionnaire after go through the brainstorming session and few design was constructed with simple sketching.After that, the sketching was draw in Solidworks 2006 to produce the 3D drawing before go through to analysis procedure. Then, the simulation process it was analysis using Algor software. The critical part was divide two it were Seating Support and Front Tire. Finally, the suitable material are obtained and was selected as material for Seating Support and Front Tire.

Chapter five discuss about the conclusion and the recommendation of the overall project. It also discuss about the further process should use to make sure this project are really succesfull.

1.6 CONCLUSION

In the early part of this chapter, the objectives and scopes of the project are stated to emphasize the mission of the project and specify the boundary of the study. At the end of this chapter, the arrangement of report is discussed briefly to give a better insight into the content of the report.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter provides with the detail description literature review done according to title of "Modification of Wheel Chair Functions for Handicap Purpose Usage". Since the aim of this project is to redesign the wheel chair drawing using Solidwork 2006 and the suitable software such as ALGOR, CADCAM and other related software. Thus literature review related definition of optimization, wheel chair and handicap. This literature review will give an overview or a brief introduction of the techniques that are suitable to be used in this project.

2.2 OPTIMIZATION

The procedures used to make a system or design as effective or functional as possible, especially the engineering techniques involved. Means that, optimization is a process or methodology of making something as a design, system or decision as fully perfect, functional and effective (Van Ryzin, et al, 1993). Conclusively, it can be referring as their improvements increased the value of the property.

2.3 WHEELCHAIR

Wheelchair is a mobility device in which the user sits. The device is propelled either manually turning the wheels by the hand or via various automated systems. Wheelchairs are used by people for whom walking is difficult or impossible due to illness like physiological or physical, injury, or disability. People with both sitting and walking disability often need to use a wheel bench. The earliest record of wheelchairs dates back to the 6th century, and was found inscribed on a stone slate in China (S.F. Simmons,et al, 2000).

2.3.1 Type of Wheelchair

Nowadays, there are many type of wheelchair that is available in the market. It is design based on different shapes and functions. Beside its main usage, wheelchair is also use for exercise activities. The types of wheelchair are manual wheelchair, electric powered wheelchair, sport wheelchair and beach wheelchair. This type was having difference system and function.

2.3.1.1 Manual Wheelchair

Manual wheelchairs are those that require human power to move them. Many manual wheelchairs can be folded for storage or placement into a vehicle, although modern wheelchairs are just as likely to be rigid framed.

Figure 2.1: Manual Wheelchair.

2.3.1.2 Electric Powered Wheelchair

Three general styles of Electric Powered Wheel chairs (EPW) exist: rear, center, front wheel driven or four wheels driven. Each style has particular handling characteristics. EPW are also divided by seat type some models resemble manual chairs, with a sling-style seat and frame, where as others have 'captain's chair' seating like that of an automobile. EPW run the gamut from small and portable models, which can be folded or disassembled, to very large and heavy full-featured chairs.

EPW may be designed specifically for indoor use, outdoor use, or both. They are generally prescribed for persons who have difficulty using a manual chair due to arm, hand, shoulder or more general disabling conditions, and do not have the leg strength to propel a manual chair with their feet.

The user typically controls speed and direction by operating a joystick on a controller. Many other input devices can be used if the user lacks coordination or the use of the hands or fingers. This controller is the most delicate and usually the most expensive part of the chair. EPW can offer various powered functions such as tilt, recline, leg elevation, seat elevation, and others useful or necessary to health and function.

EPWs use electric motors to move the wheels. They are usually powered by 4 or 5 amp deep-cycle rechargeable batteries, similar to those used to power outboard boat engines. These are available in wet or dry options. Currently dry cell batteries are more popular. Many EPW carry an on-board charger which can be plugged into a standard wall outlet older or more portable models may have a separate charger unit.

2.3.1.3 Sport Wheel chair

Disabled athletes use streamlined sport wheelchairs for disabled sports that require speed and agility such as basketball, rugby, tennis and racing. Each wheelchair sport tends to use specific types of wheelchairs, and these no longer look like their everyday cousins. They are usually non-folding it's in order to increase solidity, with a pronounced angle for the wheels which provides stability during a sharp turn and made of composite, lightweight materials. Sport wheelchairs are not generally for everyday use and are often a second chair specifically for sport use. Although some users prefer the sport options for everyday (Kulig. K, et al, 2002).

A new sport has been developed for powerchair users called powerchair football or power soccer. It is the only competitive team sport for powerchair users. The Federation Internationale de Powerchair Football Associations (FIPFA) governs the sport and is located in Paris, France with country affiliates around the world.

Figure 2.2: Sport Wheelchair.

2.3.1.4 Beach Wheelchair

This wheelchair allows users to enter the water and provide a better mobility in the sand. There are lots of different models available. In many countries in Europe where the Accessible Tourism is well set, many beaches are wheelchair accessible and provide this kind of wheelchairs to clients free of charge.

Figure 2.3: Beach Wheelchair.

2.4 HANDICAP

Handicap can be defined as the loss of ability or malfunction of the human bodies. Handicap can be categorized into several types. The condition of being unable to perform as a consequence of physical or mental unfitness such as reading disability and hearing impairment (Robert Feeney Associates, 2002). It is similarity with disability or disablement.

2.5 PREVIOUS RESEARCH OF HANDICAP PURPOSE

Several previous projects related to these applications have been studied. Several projects related to the application had been done in this chapter. The most relevant projects will be discussed briefly below and shows the summary of the previous projects.

2.5.1 Electric Wheelchair (ZUMP-3)

Prof. Dr. Rosli Abu Bakar (2008), "Design and Development Simple Electric Wheelchair for Disable Community (ZUMP-3)". An university charity program which organized by UMP vice chancellor and FKM research group. The disable people Miss Siti Hawa Binti Apandi is a teenage girl with a genetic disease called 'Spinal Muscular Atrophy Type II (SMA-2). Her body muscles could not support the weight of the body but disability does not stop her from achieve flying color result in PMR and SPM. In 2007, she successfully applied UMP as Diploma student in Computer Sciences. Her mother had to stay with her at the student hostel, just to take care of her day and night. To overcome this problem, FKM community researcher development the wheelchair based on the general information of wheelchair user. It is 4 directional sensitive joysticks with ergonomic design it is easier to use with on / off button. It also attached with 3 in 1 study table like multipurpose table and has storage compartment & safety belt.

Figure 2.4: Electric Wheelchair UMP (ZUMP-3).

2.5.2 Vacuum Cleaner

Martin, J. et al., (1994). "The prevalence of disability among adults". OPCS surveys of disability in Great Britain study about Vacuum Cleaner. The disability are cannot lift and so pushes along the floor, should chose a special lightweight cleaner for easier carrying and also difficulty in manipulating the cord. Then, it is difficulty in reaching when using and difficulty with an upright vacuum cleaner with the vertical release mechanism. The implication for measuring capabilities and the capacities of disable. The important motor factors were manipulation, lifting, gripping, and

transporting. Vacuum cleaners suggest that the ability of disabled people to carry items of different weights and weight distribution characteristics should be measured. This should be done in combination with an investigation of the handle characteristics as discussed for kettles and teapots. For the tentative of design implication are participants had most difficulty with the weight of vacuum cleaners, which relates to lifting and transporting of the device. Therefore the overall weight of vacuum cleaners needs to be reduced. Participants also had difficulty manipulating the various mechanisms of vacuum cleaners, including the on/off switch and the device that releases the vacuum cleaner from the upright position. Manipulation of the cord after use also caused difficulty. Other, easier to use mechanisms need to be designed.

2.5.3 Iron Board.

Dickerson A E and Fisher, A G. (1997). “The effects of familiarity of task and choice on the functional performance of young and old adults”. Psychology and Aging study about iron Board. The disabilities are difficulty getting close enough to the ironing board when using a wheelchair and difficulty unfolding the ironing board due to the weight. It is also too heavy and awkward to carry. Finally, the iron on a different surface as cannot use an ironing board. The implications for measuring capabilities and capacities of disabled people are also the important motor factors were manipulation, lifting, gripping, and transporting. This was emphasized by the comments recorded during the experiment. The main implication in terms of measurement is that of the weight of the device. The other factors that can be improved upon with good design principles, as discussed below. Therefore the ability of disabled people to carry items of different weights and weight distribution characteristics should be measured. The tentative of design implications should be unfolding the ironing board caused problems in terms of supporting the weight of the device while manipulating the release handle and unfolding the legs. When the ironing board has been unfolded many wheelchair users found it difficult to get close enough to the ironing board due to the configuration of the legs. Finally transporting the ironing board was found to be difficult due to the weight and the awkward shape. The problems that have been encountered suggest designing a lighter ironing board that incorporates an easy opening mechanism with legs that allow a knee hole for wheelchair users.

2.5.4 Refrigerator

Martin, J. et al. (1994). The prevalence of disability among adults. OPCS surveys of disability in Great Britain study about Refrigerator. The disabilities are about difficulty in reaching into the bottom trays for vegetables and difficulties in reaching the middle and top shelves. It also uses a small fridge mounted on the work surface to make it easier to reach. Next, it's Leans on the door for support whilst reaching into the fridge. Then, for the implications for measuring capabilities and capacities of disabled people are reaching capability of disabled people should be measured for reaching to both the front and side of the body. Also the gripping and manipulation ability of disabled people at various distances away from the body in order to determine if effectiveness of these two factors decreases with increased reaching distance. Finally, the tentative of design implication are the problem of reaching into a refrigerator is different depending on configuration. The participants had problems reaching to the bottom of single fridges, and the top and middle shelves of fridge freezers where the fridge is the top component. Modification of fridges to reduce shelf depth, or raising floor-mounted fridges should help to alleviate the problem.